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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/063,779	05/12/2002	Kay Ming Lee	NAUP0469USA	1068

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EXAMINER	
MOHAMEDULLA, SALEHA R	

ART UNIT	PAPER NUMBER
1756	

DATE MAILED: 03/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/063,779	Applicant(s) LEE ET AL.
	Examiner Saleha R. Mohamedulla	Art Unit 1756

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 May 2002*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-29* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claims 1-29 are pending.

Claim Objections

1. Claims 11-29 are objected to as they are numbered incorrectly. Claims 11-20 are all numbered as 1 and therefore, claims 21-29 are also incorrectly numbered. Correction is required.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-29 are rejected under 35 U.S.C. 102(b) as being anticipated by US# 5,879,844 to Yamamoto et al.

Yamamoto teaches an optical proximity correction method. Yamamoto teaches making first correction on design data for a first area of a mask pattern using a prepared correction table containing correction values corresponding to a pattern and surrounding layout and making a second correction on the design data, for the other area of the mask pattern than the first area

using correction amount calculated on the basis of simulation of an exposure process for a mask (col. 9, lines 5-15). For example, simulation-based correction is made on a gate layer in a memory while rule–based correction is made on a gate layer in the other area than the memory on the basis of rules for active gate width only (Abstract, col. 9, lines 25-35). Yamamoto teaches dividing a mask pattern to be corrected included in the design pattern into areas of proper size; setting an optical proximity effect calculation area by selecting one of the areas and adding buffer areas to the periphery of the selected area; making optical proximity correction on the optical proximity effect calculation area on the basis of results of calculation by a simulator that models part or the whole of a lithography process or previously prepared correction rules; fetching a result of the correction on the selected area in the optical proximity effect calculation area after the termination of the correction of the optical proximity effect calculation area and acquires the result of the correction as the result of correction of the selected area in the mask pattern to be corrected; and when the buffer areas include area in which a pattern has corrected, setting the corrected pattern into the buffer areas (col. 12, lines 5-20). For areas which do not overlap, a group of uncorrected patterns is set as an initial input patern group in the correction processing. For areas which do overlap, a group of correction completed patterns is set as an initial input patter group. Thereby, correction calculation can be initiated with a pattern close to a correction solution as an initial input pattern (col. 12, lines 33-35). Table 3 shows correction values calculated for a given exposure and mask condition (col. 15, line 45-67). Yamamoto teaches correcting the layout shown in Figure 16 (col. 16, lines 1-5). Figure 16 is a layout with different densities. The layout has semi-dense and isolated patterns.

4. Claims 1-29 are rejected under 35 U.S.C. 102(b) as being anticipated by US# 5,916,716 to Butsch et al.

Butsch teaches that across chip line width variations and other repetitive deviations from the design pattern desired are compensated for by examining each of the regions of a patterned substrate, determining the amount of deviation for each region, and using the determined regional deviation as a local bias when patterning subsequent substrates (Abstract). Thus, the E-beam lithography tool will utilize both global and local biases in order to produce new patterns. Butsch teaches that horizontal and vertical deviations from the design pattern are determined for a plurality of regions on the substrate, where the regions can constitute different fields, sub-fields, frames or stripes. The deviations are used as a local bias such that each region of the substrate being patterned has both global and local biases and the resulting substrate lacks the repetitive pattern deviations which are produced when local biasing is not used (col. 1, lines 55-67). The tool can be provided for writing wider or narrower lines (col. 2, lines 5-10). Butsch teaches that each field is built up from a plurality of sub-fields. Patterns are created in the fields from several discrete patterns in the sub-fields. The patterns can be defined by rectangles or blocks (col. 2, lines 60-65). The difference in image size between the design shapes and the patterned images which are ultimately produced is referred to as "bias" or "etch" (col. 3, lines 20-23). Global bias helps compensate for process variations that result from choice of resist, choice of developer, plating material, type of etching, periodic column charging, variations in the speed of movement of the wafer table, or other process parameters (col. 3, lines 35-45). Butsch also teaches that tool commands must be revised for each region to specify larger or smaller line width dimensions. Therefore, Butsch teaches different densities (col. 5, lines 20-25). Butsch

teaches after performing the process steps, the line width variation for each of a plurality of regions is known. A look up table will then be constructed which includes for each region the line width variation, the current density required to achieve the line width variation, and the optimum focus for the current density (col. 6, lines 18-25). Butsch also teaches making masks with corrections derived from either the mask or the final wafer (col. 6, lines 30-34).

5. Claims 1-29 are rejected under 35 U.S.C. 102(b) as being anticipated by US# 6,120,953 to Lin.

Lin teaches an optical proximity correction method. When the critical dimension is reduced to reach a first reference value or below, a serif/hammerhead is added onto the main pattern. When the critical dimension is further reduced to a second reference value or below, an assist feature is added onto the main pattern. The corrected pattern is then transferred to a layer on wafer with an improved fidelity (Abstract). Using the critical dimension (CD) of an original main pattern as a determinant of whether an optical proximity correction is performed on the original main pattern, neither an empirical result nor a relationship between two adjacent layers is required. Therefore, data handling is simplified while fidelity of a transferred pattern is retained. In the invention, an original pattern to be transferred is provided. The critical dimension of the original pattern is obtained. When the critical dimension is less than or equal to 2.5 times of a wavelength of an exposure light source, serifs are added on each corner of the original pattern, or a hammerhead is added onto each trunk of the pattern. If the critical dimension is less than or equal to the wavelength, an assist feature is added into the original pattern. The original pattern is thus corrected for forwarding an exposure step of a

photolithography process. In addition, by correcting the original in a sequence of adding the serifs and hammerhead in front of adding the assist feature, an overlap in the corrected pattern or an overly reduced distance is avoided (col. 2, lines 20-40). The addition of serifs or the hammerhead improves fidelity of the pattern, while the addition of the assist feature increases a contrast of the pattern to result in a higher resolution. In Figure 3B, Lin teaches that a distance between two neighboring patterns is too small and that in some occasions, the patterns may even overlap with each other to cause connections (col. 3, lines 37-46). Therefore, Lin teaches the different densities.

6. Claims 1-29 are rejected under 35 U.S.C. 102(e) as being anticipated by US# 6,475,684 to Ki.

Ki teaches that a variation in line width caused by a loading effect generated due to the non-uniformity of a loading density is reduced by a method of performing correction exposure using a dose corresponding to the loading effect due to a desired pattern which is calculated from a relationship represented as the convolution of a Gaussian distribution and a loading density (Abstract). Ki teaches macro and micro loading effects. Ki also teaches that the line width of a portion of the opaque layer having a high loading density is larger than that of a portion of the opaque layer having a low loading density (col. 1, lines 15-35). The line width variation due to the loading effect caused upon dry etching can be largely corrected by adjustment of an etching condition or by exposure with an additional compensation dose (col. 1, lines 45-60). Ki teaches the method of correcting a variation in line width due to a loading effect generated when the material layer on a photomask substrate is dry-etched to have a

desired pattern, in which, first, a loading effect range is obtained by dividing the substrate into meshes, and supposing the distribution of a loading effect frequency representing the degree of a loading effect at an arbitrary mesh on the substrate from each of the meshes to be a Gaussian distribution expressed in an equation. Next, the loading density of the desired pattern, which is defined as a ratio of the area to be etched to the entire area in each mesh, is calculated. The loading effect at each of the meshes on the substrate can be calculated by convoluting the loading density of the desired pattern and the loading effect frequency obtained from the loading effect range. An electron beam resist is correction-exposed according to the loading effect calculated at each of the meshes on the substrate. In this way, a variation in line with is corrected (col. 2, lines 5-30). The step of obtaining a loading effect range can include the step of forming test patterns by exposing, developing and etching a photomask substrate, and measuring the line width of the test pattern, and the step of calculating the loading effect expressed as the above-described equation an arbitrary loading effect range value, comparing the loading effects with the line widths of the test pattern at the meshes, and selecting a loading effect range in which the deviation between them is minimum (col. 2, lines 40-50). Figure 1 shows the sequence of correcting line width variation generated due to loading effect. Ki teaches a photomask in Figure 4B. Since the basic patterns occupy very small areas on the photomask substrate, the right side of the photomask substrate has a very high loading density and the left portion of the substrate has a very low loading density (col. 5, lines 50-55). A large loading effect is shown at the center of the substrate having many peripheral patterns while a small loading effect is shown at the edge of the substrate having a small number of peripheral patterns (col. 6, lines 30-40).

7. Claims 1-29 are rejected under 35 U.S.C. 102(e) as being anticipated by US# 6,586,146 to Chang et al.

Chang teaches a method of figuring an exposure energy. A first CD deviation is obtained from a layer before the exposing layer. From the first CD deviation, a first energy compensation is calculated. Whether the deviation of photoresist sensitivity of two sequential batches is less than 1% is checked. If the deviation of photoresist sensitivity of two sequential batches is less than 1%, a sum of the required exposure energy and the first energy compensation is the exposure energy applied to the exposing layer. Otherwise, a second CD deviation is commutated according to the deviation of photoresist sensitivity of two sequential batches. A second energy compensation is then obtained from the second CD deviation, and a sum of the required exposure energy and the first/second energy compensation is the exposure energy applied to the exposing layer (Abstract). The first energy compensation is calculated using the CD deviation. That is, the CD deviation is derived from the thin film thickness of the layer prior to the exposing layer and a critical dimension specification target (col. 2, lines 55-61). In Figure 5, the linear regression formula of the critical dimension and the exposure energy is used to obtain the first energy compensation (col. 3, lines 24-28). In the method of calculating the second CD deviation, the linear correlation between the photoresist sensitivity and the critical dimension is used to obtain the second CD deviation (col. 3, lines 55-60). A second energy compensation is obtained from the second CD deviation. The second CD deviation is substituted into the linear correlation formula that was used to obtain the first energy compensation (col. 4, lines 10-15).

Conclusion

8. Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Saleha Mohamedulla whose telephone number is (571) 272-1387. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM.

If attempts to reach the Examiner by telephone are unsuccessful, the Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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Technology Center 1700
March 8, 2004